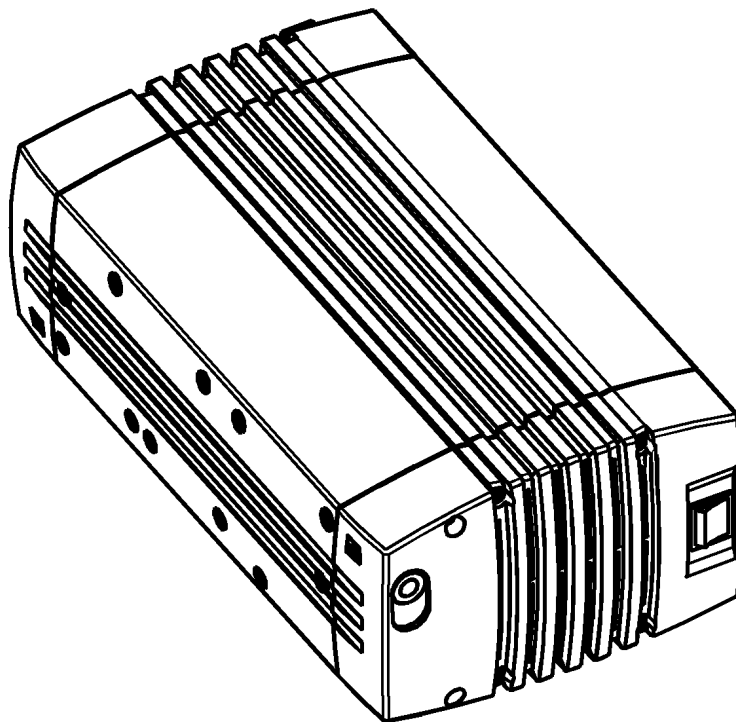


OEM

**N 920
TRANSLATION OF ORIGINAL OPERATING AND
INSTALLATION INSTRUCTIONS
ENGLISH**

DIAPHRAGM VACUUM PUMP



Note!

Before operating the pump and the accessories, please read the operating instructions and pay attention to the safety precautions!

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1. About this document

1.1. Using the Operating and Installation Instructions

The Operating and Installation Instructions are part of the pump.

- ➔ Always keep the Operating and Installation Instructions handy in the work area.
- ➔ Pass on the Operating and Installation Instructions to the next owner.

Project pump

Customer-specific project pumps (pump models which begin with “PJ” or “PM”) may differ from the Operating and Installation Instructions.

- ➔ For project pumps, also observe the agreed upon specifications.

1.2. Symbols and markings

Warning



WARNING

A danger is located here.

Possible consequences of a failure to observe the warning are specified here. The signal word, e.g. Warning, indicates the danger level.

- ➔ Measures for avoiding the danger and its consequences are specified here.

Danger levels

Signal word	Meaning	Consequences if not observed
DANGER	warns of immediate danger	Death or serious injuries and/or serious damage are the consequence.
WARNING	warns of possible danger	Death or serious injuries and/or serious damage are possible.
CAUTION	warns of a possibly dangerous situation	Minor injuries or damage are possible.

Tab. 1

Other information and symbols

- ➔ An activity to be carried out (a step) is specified here.
- 1. The first step of an activity to be carried out is specified here. Additional, consecutively numbered steps follow.



This symbol refers to important information.

2. Use

2.1. Proper use

The pumps are exclusively intended for transferring gases and vapors.

Owner's responsibility

Operating parameter and conditions

Only install and operate the pumps under the operating parameters and conditions described in Chapter 4. Technical Data.

Only complete pumps may be taken into service.

Make sure that the installation location is dry and the pump is protected against rain, splash, hose and drip water as well as other pollutions.

The gas-tightness of the connections between the application pipes and the pump (or the pump connection) must be checked regularly; with leaky connections, there is a danger that hazardous gases or vapors may escape from the pump system.

Requirements for transferred medium

Before using a medium, check whether the medium can be transferred danger-free in the specific application case.

Before using a medium, check the compatibility of the materials of the components in contact with the medium (see Chapter 4. Technical Data) with the medium.

Risk of hazardous gas mixtures during pump operation if diaphragm ruptures: Depending on the medium transferred, a hazardous mixture may be produced in the case that the diaphragm ruptures, if the medium mixes with the air in the compressor housing.

Only transfer gases which remain stable under the pressures and temperatures occurring in the pump.

2.2. Improper use

The pumps may not be operated in an explosive atmosphere.

The pumps are not suitable for transferring:

- dusts
- liquids
- aerosol
- biological and microbiological substances
- fuel
- explosive and combustible materials
- fibers
- oxidizing agent
- foodstuffs.

The pumps are not suitable for use with aggressive media. Other pumps in the KNF product line are designed for use with aggressive media. Please contact us for more information.

The pumps must not be used to create vacuum and overpressure simultaneously.

An overpressure must not be applied to the suction side of the pump.

3. Safety

i Note the safety precautions in Chapter 7. Installation and connection and 8. Operation.

The pumps are built according to the generally recognized rules of the technology and in accordance with the occupational safety and accident prevention regulations. Nevertheless, dangers can result during their use which lead to injuries to the user or others, or to damage to the pump or other property.

Only use the pumps when they are in a good technical and proper working order, in accordance with their intended use, observing the safety advice within the Operating and Installation Instructions, at all times.

Components connected to the pump must be designed to withstand the pneumatic performance of the pump.

Take care that safety regulations are observed when connecting the pump to the electricity supply.

Personnel Make sure that only trained and instructed personnel or specially trained personnel work on the pumps. This especially applies to assembly, connection and servicing work.

Make sure that the personnel has read and understood the Operating and Installation Instructions, and in particular the “Safety” chapter.

Working in a safety conscious manner

Observe the accident prevention and safety regulations when performing any work on the pump and during operation.

For pump N 920 APE-W: Open housing parts with notice sticker (see Fig. 1) only after separating mains plug from power source.

Ensure that the pump is separated from the mains and is de-energized.

Make sure that there are no hazards due to flow with open gas connections, noises or hot gases.

Ensure that an EMC-compatible installation of the pump is ensured at all times and that this cannot lead to a hazardous situation.

Handling dangerous media

When transferring dangerous media, observe the safety regulations when handling these media.

If the diaphragm ruptures, the transferred medium will mix with the air in the environment.

Take all necessary care to prevent this leading to a dangerous situation.

Handling combustible media

Be aware that the pumps are not designed to be explosion-proof.

Make sure the temperature of the medium is always sufficiently below the ignition temperature of the medium, to avoid ignition or explosion. This also applies for unusual operational situations.

Note that the temperature of the medium increases when the pump compresses the medium.



Fig. 1: notice sticker

	<p>Hence, make sure the temperature of the medium is sufficiently below the ignition temperature of the medium, even when it is compressed to the maximum permissible operating pressure of the pump. The maximum permissible operating pressure of the pump is stated in the technical specifications (Chapter 4).</p> <p>If necessary, consider any external sources of energy, such as radiation, that may add heat to the medium.</p> <p>In case of doubt, consult the KNF customer service.</p>
Environmental protection	<p>Store all replacement parts in a protected manner and dispose of them properly in accordance with the applicable environmental protection regulations. Observe the respective national and international regulations. This especially applies to parts contaminated with toxic substances.</p>
EU/EC Directives / Standards	<p>For the purposes of the Machinery Directive 2006/42/EC, pumps are “partly completed machinery”, and are therefore to be regarded as not ready for use. Partly completed machinery may not be commissioned until such time as it has been determined that the machine in which the partly completed machinery is to be assembled is in conformity with the provisions of the Machinery Directive 2006/42/EC. The following essential requirements of Annex I of Directive 2006/42/EC (general principles) are applied and observed:</p> <ul style="list-style-type: none"> – General Principles No. 1 – No. 1.1.2. / 1.1.3. / 1.3.1. / 1.3.3. / 1.3.4. / 1.4.1. / 1.5.1.* / 1.5.2.* / 1.5.8. / 1.5.9. / 1.7.4. / 1.7.4.1. / 1.7.4.3. – (*only for N 920 APE-W) <p>As these partly completed machinery are OEM-models the power supplies and the equipment for disconnecting and switching-off the partly completed machinery respectively have to be considered when mounting as well as over-current and overload protective gear.</p> <p>In addition a protection against mechanical parts in motion and hot parts, if existing, has to be provided when mounting.</p> <p>The safety objectives of the following Directive(s) have been met:</p> <ul style="list-style-type: none"> ▪ Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (Annex II amended by Commission Delegated Directive (EU) 2015/863). ▪ Only for N920APE-W : Directive 2014/35/EU on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits in accordance with Annex I, No. 1.5.1. of the Directive 2006/42/EC.

The following harmonized standards were taken as a basis:

N 920 APE-W	N 920 APDC-B
EN 61326-1 (Class A)	EN 61326-1 (Class A)
EN IEC 61000-6-2/3	EN IEC 63000
EN 60204-1	
EN IEC 63000	

Tab. 2

Customer service and repairs

The pump is maintenance-free. But KNF recommends, checking the pump regularly with regard to conspicuous changes in noise and vibrations.

Only have repairs to the pumps carried out by the KNF Customer Service responsible.

Housing with voltage-carrying parts may be opened by technical personnel only.

Use only genuine parts from KNF for servicing work.

4. Technical Data

Pump materials

Assembly	Material
Pump head	Aluminum
Diaphragm	EPDM
Valve	EPDM

Tab. 3

Pneumatic values

Parameter	Value
Max. permissible operating pressure [bar g]	0.5
Ultimate vacuum [mbar abs.]	< 1.5
Delivery rate [l/min]*	21

Tab. 4

*Liters in standard state (1013 mbar)

Pneumatic Connections

Pump type	Value
Thread size	G 1/8

Tab. 5

Electrical data

N 920 APE-W

Parameter	Value
Automatic mains power adjustment	100-240V 50/60 Hz
Max. operating current [A]	1.3
Power consumption pump [W]	120
Maximum permitted mains voltage fluctuations	+/- 10%
Protection class Motor	IP 20

Tab. 6

i The pump is supplied by a universal power supply with integrated overload protection. It is protected against overheating by a temperature sensor on the motor board and equipped with overcurrent protection.

If one of these safety functions is triggered, the pump will be shut down and must be manually reset, as follows:

- ➔ Separate pump from electrical power supply
- ➔ Remove the cause(s) of the fault before restarting.

N 920 APDC-B

Parameter	Value
Motor type	Brushless DC motor
Voltage [V]	24 V
Max. operating current [A]	4.2 (starting current, momentary 200 ms: 7A)
Power consumption pump [W]	100
Maximum permitted mains voltage fluctuations	+/- 10%
Protection class Motor	IP 00

Tab. 7

i The pump is supplied by a universal power supply with integrated overload protection. It is protected against overheating by a temperature sensor on the motor board and equipped with overcurrent protection.

If one of these safety functions is triggered, the pump will be shut down and must be manually reset, as follows:

- ➔ Separate pump from electrical power supply
- ➔ Remove the cause(s) of the fault before restarting.

Weight

Pump type	Value
N 920 APE-W	10.0 kg
N 920 APDC-B	8.5 kg

Tab. 8

Other parameters

Parameter	Value
Permissible ambient temperature	+ 10°C bis + 40°C
Permissible media temperature	+ 5°C bis + 40°C
Dimensions L x H x W [mm]: N 920 APE-W N 920 APDC-B	324 x 182 x 127 292 x 161 x 119
Maximum permissible ambient relative humidity	80% for temperatures up to 31°C, decreasing linearly to 50% at 40°C.
Max. altitude of site: [m above sea level]	2000

Tab. 9

5. Design and function

Design N 920 APE-W

- 1 Inlet (suction side)
- 2 Outlet (pressure side)
- 3 Potentiometer (special design)
- 4 Power switch

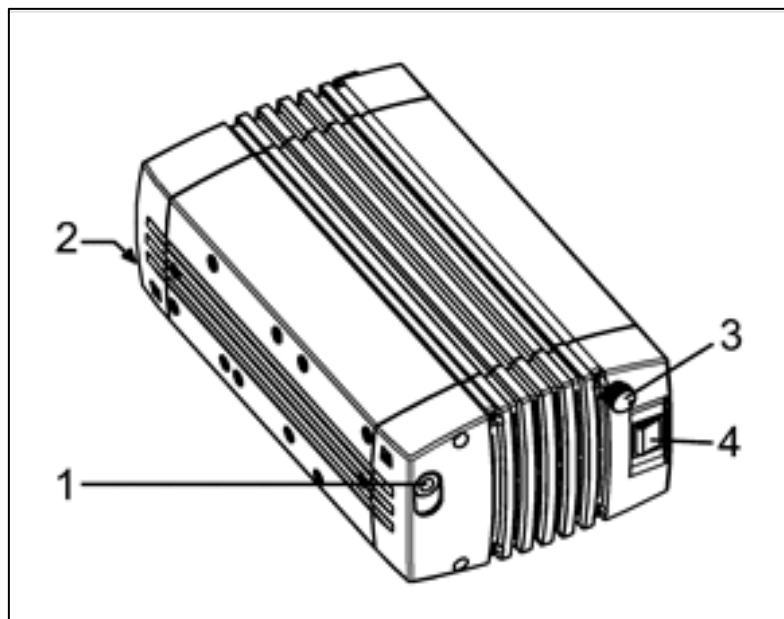


Fig. 2: Design N 920 APE-W

Design N 920 APDC-B

- 1 Motor control electronics
- 2 Inlet (suction side)
- 3 Outlet (pressure side)

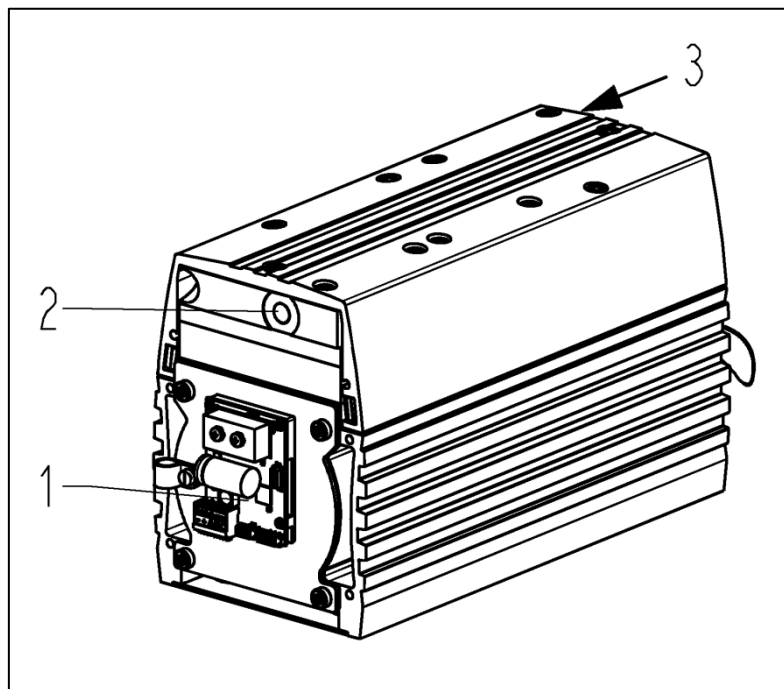


Fig. 3: Design N 920 APDC-B

Function Diaphragm Pump

- 1 Outlet valve
- 2 Inlet valve
- 3 Transfer chamber
- 4 Diaphragm
- 5 Eccentric
- 6 Connection rod
- 7 Pump drive

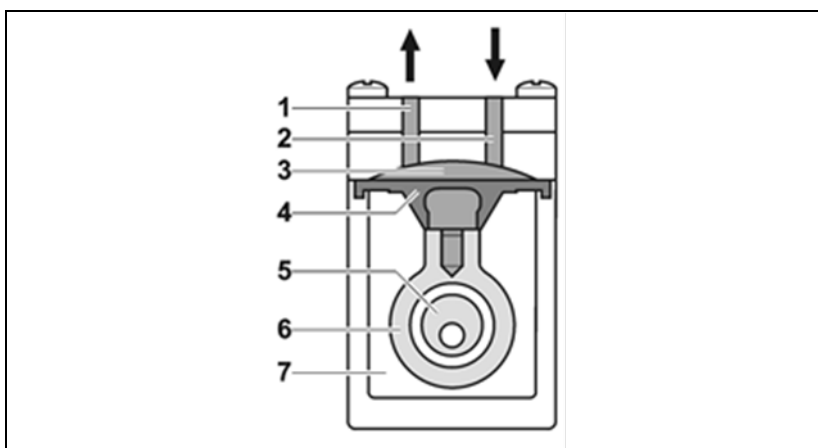


Fig. 4: Pump head

Diaphragm pumps transfer, compress (depending on pump version) and evacuate gases and vapors.

The elastic diaphragm (4) is moved up and down by the eccentric (5) and the connection rod (6). In the downward stroke it aspirates the gas to be transferred via the inlet valve (2). In the upward stroke, the diaphragm presses the medium out of the pump head via the outlet valve (1). The transfer chamber (3) is hermetically separated from the pump drive (7) by the diaphragm.

Function diaphragm stabilization system

- 1 Balancing connection for vacuum chamber
- 2 Vacuum chamber
- 3 Stabilization diaphragm

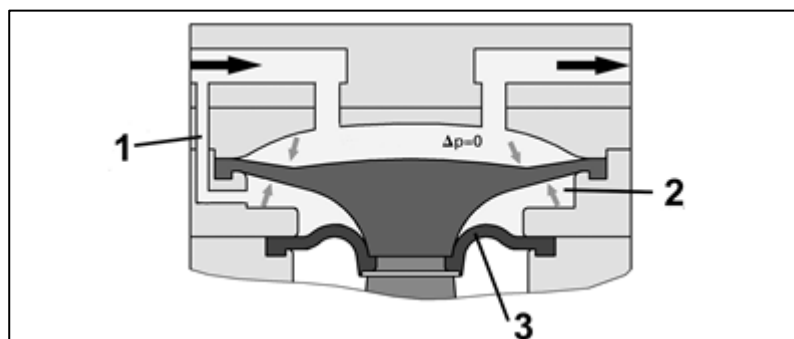


Fig. 5: Function diaphragm stabilization system

An additional diaphragm, the so-called stabilization diaphragm (3), separates the underside of the working diaphragm from the "crank" space of the pump (see Fig. 5). The space between the two diaphragms, called a vacuum chamber (2), is connected with the suction side of the pump via an balancing connection (1). This way, the vacuum chamber has approximately the same pressure as the working space of the diaphragm pump. The pressure difference between the upper and underside of the diaphragm approaches zero. The working diaphragm remains stable, independent of the inlet pressure of the pump. This improves the suction speed of the pump significantly, over its entire working range.

6. Transportation



CAUTION

Physical injury and/or property damage due to incorrect or improper transport of the pump.

Incorrect or improper transport may cause the pump to fall, be damaged or injure persons.

- ➔ If necessary, use suitable aids (carrying strap, lifting device, etc.).
- ➔ If necessary, wear suitable personal protective equipment (e.g. safety shoes, safety gloves).



CAUTION

Risk of injury due to sharp edges on the packaging

There is a possibility of injury by cutting on the sharp edges while gripping on edges or when opening the packaging.

- ➔ If necessary, wear suitable personal protective equipment (e.g. safety shoes, safety gloves).

- ➔ Transport the pump in its original packaging to the installation location.
- ➔ Store the original packaging of the pump (for example, for future storage).
- ➔ Check the pump for transport damage upon receipt.
- ➔ Document damage that has occurred during transport in writing.
- ➔ If necessary, remove the transport safety devices before commissioning the pump.

Parameter

Parameter	Value
Storage temperature	+ 5°C to + 40°C
Transport temperature	- 10°C to + 60°C
Permiss. Humidity (non-condensing)	30% to 85%

Tab. 10

7. Installation and connection

Only install and operate the pumps under the pneumatic operating parameters and conditions described in Chapter 4, Technical Data. Observe the safety precautions (see Chapter 3).

7.1. Installation of the pump

- ➔ Choose a safe location (flat surface) for the pump.
- ➔ Before installation, store the pump at the installation location to bring it up to ambient temperature.

Mounting dimensions

- ➔ See Fig. 6 (N 920 APE-W) and Fig. 7 (N 920 APDC-B) for mounting dimensions.

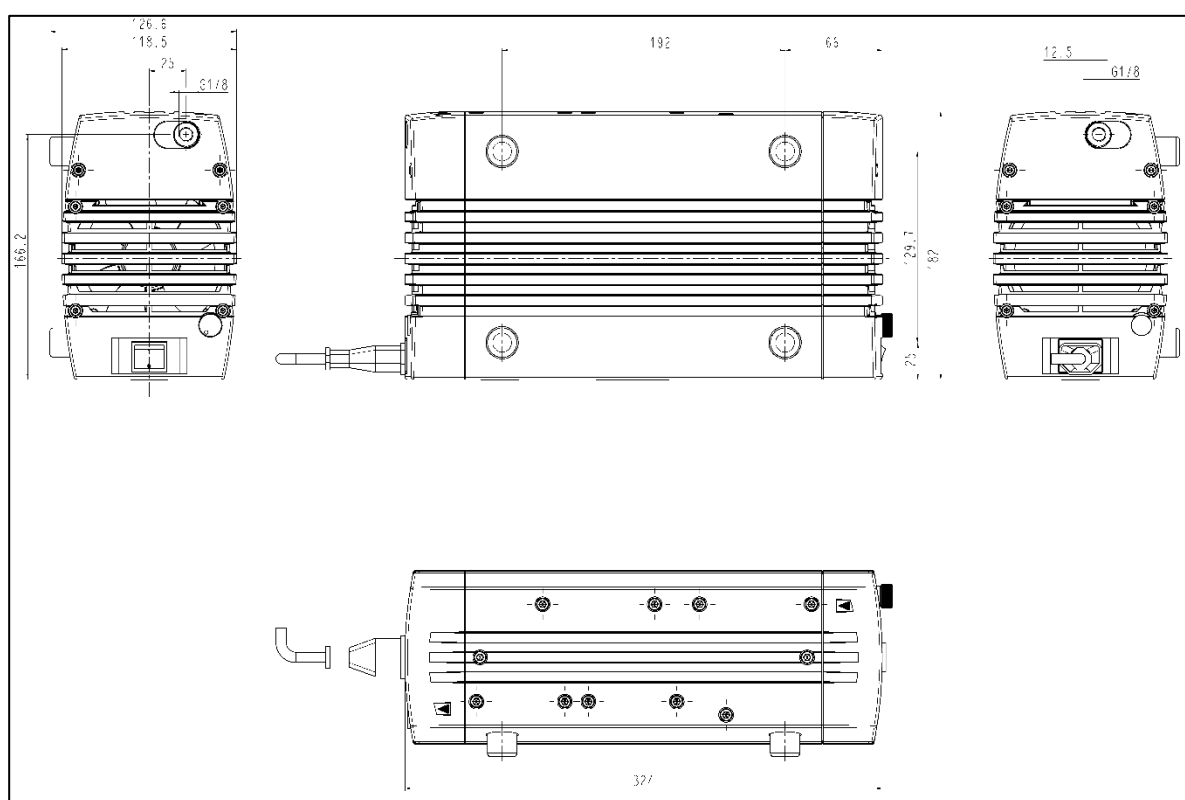


Fig. 6: Mounting dimensions pump series N 920 APE-W (All dimensional tolerances conform to DIN ISO 2768-1, Tolerance Class V)

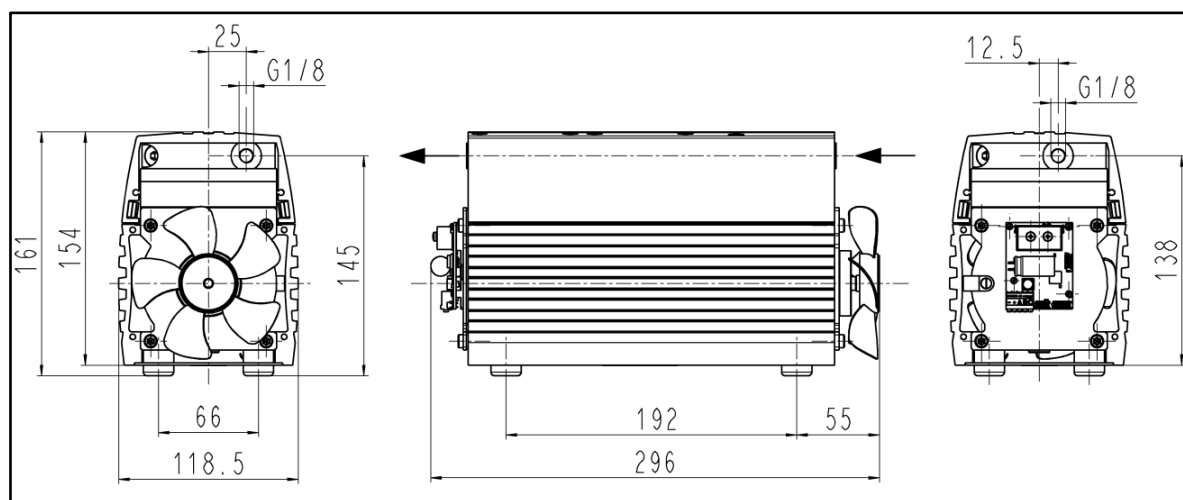


Fig. 7: Mounting dimensions pump series N 920 APDC-B (All dimensional tolerances conform to DIN ISO 2768-1, Tolerance Class V)

Cooling air supply



Danger of burns from hot surfaces

Hot surfaces may be caused by overheating of the pump.

WARNING

→ Install the pump so that the motor fan can intake sufficient cooling air.

Installation location

→ Make sure that the installation location is dry and the pump is protected against rain, splash, hose and drip water as well as other pollutions.

→ Make sure, that the installation location is accessible for maintenance and service.

i The IP protection class of the pump motor is indicated on the type plate.

→ Install the pump at the highest point in the system to prevent condensate from collecting in the pump head.

→ Protect the pump from dust.

→ Protect the pump from vibrations and jolts.



Personal injury and/or damage to property because of vibration

In conjunction with adjacent components, vibration of the pump may result in crushing and/or damage to these components.

WARNING

→ Make sure that vibrations of the pump do not result in hazards associated with adjacent components.

Protection against touching and
foreign objects

For pump N 920 APDC-B:



WARNING

Hazard of injuries during operation

- ➔ Take protective measures against touching parts connected to electrical power (electrical connection).
- ➔ Take protective measures against touching moving parts (e.g. fans).

Hazard of damage to the pump during operation

- ➔ Take protective measures against foreign objects which could enter the pump.
-

7.2. Electrical connection

N 920 APE-W

1. Compare the supply data with the data on the motor-plate.
2. Insert the power cable's plug into a properly installed shock-proof socket.

N 920 APDC-B



Extreme danger from electrical shock

DANGER

- Only have the pump connected by an authorized specialist.
- Only have the pump connected when the power supply is disconnected.

- When connecting the device to a power source, the relevant standards, directives, regulations, and technical standards must be observed.
- In the electrical installation, arrangements (complying with EN 60335-1) must be made for disconnecting the pump motor from the electrical supply.
- The motors of the pump must be protected according to EN 60204-1 (protection against excess current, or overloading).
- i** For max. operating current of the pump see pump's type plate.
- It is recommended that an additional "Emergency Stop" switch is installed.
- The pump must be installed so that contact with live parts is impossible.

Attach connection cables

- Fasten the connection cables so that:
 - the cables do not contact moving or hot parts.
 - the cables will not chafe or be damaged on sharp edges or corners.
 - no pulling or pushing forces are exerted on the cable's connection points (strain relief).

Connecting pump

1. Compare the supply data with the data on the motor plate. For maximum operating current of the pump see pump's type plate.
2. Connect the positive and negative pole.



Note the proper polarity:

red connection cable: +

black connection cable: -

Incorrect lead connection will damage electronics of brushless DC motors (type designation ending with B). The supply wires have inverse-polarity protection on the motor board for this purpose, while the control-voltage wires do not have this protection function.



Control voltage may only be applied if the motor controller is supplied with operating voltage. Otherwise damages can occur on the motor controller.

7.3. Pneumatic connection



CAUTION

Personal injury or damages to property by ejected protective plugs

If the protective plug at the pressure side of the pump hasn't been removed, it could be ejected because of the overpressure during operation.

→ Remove the protective plug during the installation.

Connected components	→ Only connect components to the pump which are designed for the pneumatic data of the pump (see Chapter 4, Technical Data).
Pump exhaust	→ If the pump is used as a vacuum pump, safely discharge the pump exhaust at the pump's pneumatic outlet.
Disengaging	→ KNF recommends mechanically disengaging the pump from the piping system. This can be achieved with flexible tubing or pipes, for example. This will avoid transferring to the system any pump oscillations that may arise.

Connecting pump



A marking on the pump head shows the direction of flow.



CAUTION

Risk of injury due to mixing up suction and pressure side

Confusion between suction and pressure sides can lead to breakage of connected components on the suction and pressure sides.

→ Observe the marking of the inlet/outlet.

1. Remove the protective plugs from the hose connection threads.
 2. The accessories silencer, filter, and hose connectors (where applicable) are screwed into the port threads.
- i** The filter or silencer is to be mounted on the suction side or pressure side of the pump head. With multiple-head pumps, this relates to the first pump head or last pump head.
3. Connect the suction line and pressure line (see Chapter 4, Tab. 9 for mounting dimensions).
 4. Lay the suction and pressure line at a downward angle to prevent condensate from running into the pump.

8. Operation

8.1. General



Danger of burns from hot pump parts or hot medium

During or after operation of the pump, some pump parts may be hot.

WARNING

- Allow the pump to cool after operation.
 - Take safety precautions against the contact of hot parts/media.
-



Injury of the eyes

During excessive approach to the inlet or outlet of the pump, the eyes could be injured by the upcoming vacuum or overpressure.

WARNING

- Don't look into the pump's inlet or outlet during the operation.
-

- Only operate the pumps under the operating parameters and conditions described in Chapter 4. Technical Data.
 - Make sure the pumps are used properly (see Chapter 2.1).
 - Make sure the pumps are not used improperly (see Chapter 2.2).
 - Observe the safety precautions (see Chapter 3).
 - The pumps are intended for installation. Before putting them into service it must be established that machinery or equipment in which they are installed meets the relevant regulations.
-



Hazard of the pump head bursting due to excessive pressure increase

WARNING

- Do not exceed max. permissible operating pressure (see Chapter 4. Technical Data).
 - Monitor pressure during operation.
 - If the pressure exceeds the maximum permissible operating pressure, immediately switch off pump and eliminate fault (see Chapter 10. Troubleshooting).
 - Only throttle or regulate the air or gas quantity in the suction line to prevent the maximum permissible operating pressure from being exceeded.
 - If the air or gas quantity in the pressure line is throttled or regulated, make sure that the maximum permissible operating pressure is not exceeded.
 - Ensure that the pump outlet is not closed or constricted.
-

i Excessive pressure (with all of the related hazards) can be prevented by placing a bypass line with a pressure-relief valve between the pressure and suction sides of the pump. For further information, contact our technical adviser (contact data: see www.knf.com).



WARNING

Risk of hazardous gas mixtures during pump operation if working diaphragm ruptures

If the diaphragm ruptures, the medium mixes with the air in the compressor housing.

➔ Diaphragm must be replaced before further operation (see chapter 9. Servicing).

Pump standstill

➔ With the pump at a standstill, open pressure and suction lines to normal atmospheric pressure.

i The pump may not start up against pressure or vacuum during switch-on. This also applies in operating following a brief power failure. If a pump starts against pressure or vacuum, it may block, and the integrated overload protection switches the pump off.

➔ Make sure that normal atmospheric pressure is present in the lines during switch-on.

➔ Only pump N 920 APE-W: Switch on pump with mains switch (see Fig. 2).

i Depending on the level of the applied electrical voltage, initialization of the electronics can take up to one second, before the pump starts.

Vapors as media

The life of the diaphragm is prolonged the formation of condensate is avoided. Therefore the following precautions should be taken:

➔ Run the pump for a few minutes to warm it up before handling saturated or nearly saturated vapors.

➔ KNF recommends: When transferring aggressive media, flush the pump prior to switch off (see Chapter 9.2.1) to increase the service life of the diaphragm.

Switching off the pump /
removing from operation

➔ Only pump N 920 APE-W: Switch off pump with mains switch (see Fig. 2).

➔ Restore the system to normal atmospheric pressure (release pneumatic pressure in pump).

➔ Only pump N 920 APE-W: Disconnect the power source.

Adjusting flow rate

N 920 APE-W

The flow rate cannot be varied.

N 920 APE-W with potentiometer (special design)

The pump's speed can be varied via the potentiometer (Fig. 2/3).
The flow rate can be adjusted this way.

8.2. Control

i Only for pumps with external actuation at the control cable connection.

- Control cable and Level-Translator, see accessories on page 39.
- Control pin assignments, see Tab. 12, page 24.

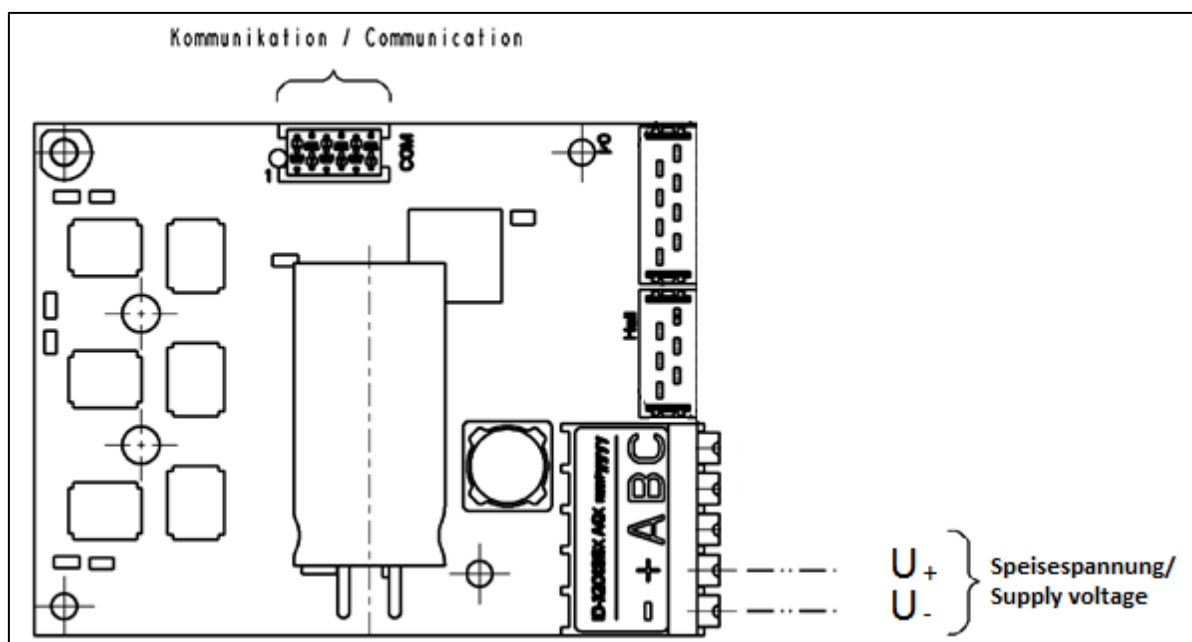
N 920 APDC-B

Fig. 8: Connection plan motor electronics N 920 APDC-B

Motor			
Nennspannung / Nominal voltage	[V]	24	
Spannungsbereich / Voltage range	[V]	7 ... 30	
Elektrische Anschlüsse / Electrical connection			
Litzenbelegung / lead assignment			
Funktion / function	Litzenfarbe lead color	Signalname signal name	Größe / size
+ Speisespannung + Supply voltage	rot / red	U+	AWG 18
- Speisespannung - Ground (0V)	schwarz / black	U- / GND	AWG 18

Tab. 11 : Connection plan motor electronics N 920 APDC-B

N 920 AP.29DC-B

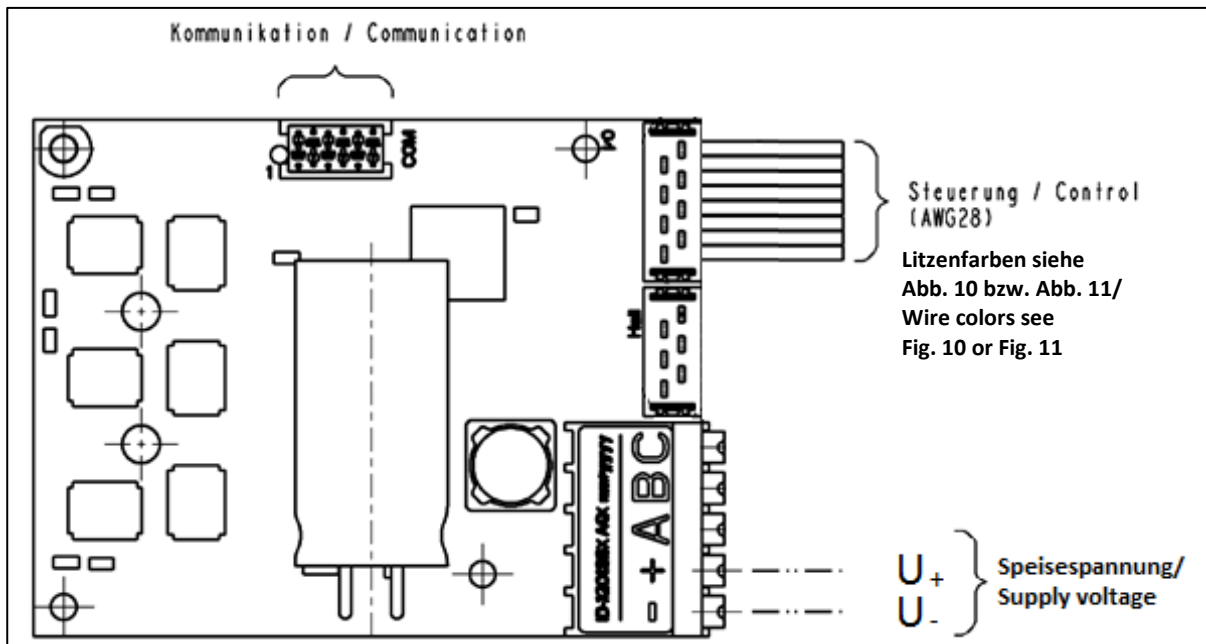


Fig. 9: Connection plan motor electronics N 920 AP.29DC-B

Motor			
Nennspannung / Nominal voltage		[V]	24
Spannungsbereich / Voltage range		[V]	7 ... 30
Elektrische Anschlüsse / Electrical connection			
Litzenbelegung / lead assignment			
Funktion / function	Litzenfarbe lead color	Signalname signal name	Größe / size
+ Speisespannung + Supply voltage	rot / red	U ₊	AWG 18
- Speisespannung (0V) - Ground (0V)	schwarz / black	U ₋ / GND	AWG 18
5V Ausgangsspannung 5V power supply	schwarz / black	U _{5V}	AWG 28 UL 20932
Eingangssignal Drehzahlregelung Input signal speed control	weiß / white	U _{Ctrl}	AWG 28 UL 20932
Ausgangssignal Drehzahl Output signal speed	gelb / yellow	U _{Spd}	AWG 28 UL 20932
Eingangssignal Remote EIN/AUS Input signal Remote ON/OFF	grün / green	U _{Rmt}	AWG 28 UL 20932
Ausgangssignal Fehler Output signal fault	lila / purple	U _{Flt}	AWG 28 UL20932
Masse Ground	grau & blau & orange grey & blue & orange	GND	AWG 28 UL 20932
5V Ausgangsspannung U _{5V} / 5V Power supply U _{5V}			
Ausgangsspannung DC Control voltage range DC		[V]	5 ± 0.2
Max. Ausgangsstrom Max. current output		[mA]	170

Tab. 12 (part 1): Connection plan motor electronics N 920 AP.29DC-B

Eingangssignal Drehzahlregelung U_{Ctrl} / Input signal speed control U_{Ctrl}				
Analog	Steuerspannungsbereich DC Control voltage range DC	[V]	0 ... 5	
	Steuerspannungsbeschreibung: min. → Pumpe min. Förderleistung max. → Pumpe max. Förderleistung Contol voltage description min. → pump min. flow max. → pump max. flow	[V]	min. 0.1	max. 5
	Max. Eingangsspannung Max. input voltage	[V]	5.5	
	Schwellenspannung Treshold voltage	[mV]	25 ± 0.5	
PWM-Signal	PWM Frequenzbereich PWM frequency range	[Hz]	100 [50 ... 150]	
	Eingangspegel „high“ Input level „high“	[V]	5 [4.2 ... 5.5]	
	Eingangspegel „low“ Input level „low“	[V]	0 [0 ... 0.9]	
	Tastgradbereich Duty cycle range	[%]	0 ... 100	
	Tastgradbeschreibung: min. → Pumpe min. Förderleistung max. → Pumpe max. Förderleistung Duty cycle description min. → pump min. flow max. → pump max. flow	[%]	min. 2	max. 100
Eingangsimpedanz @ 1kHz Input impedance @ 1kHz		[kΩ]	≥ 12	
Ausgangssignal Drehzahl U_{Spd} / Output signal speed U_{Spd}				
Analog	Pulse pro Umdrehung Pulses per revolution	[-]	1	
	Pulstastverhältnis Pulse duty cycle	[%]	50 ± 1	
PWM-Signal	PWM Frequenz PWM frequency	[Hz]	50 ± 0.5	
Ausgangspegel „high“ Output level „high“		[V]	5 [4.1 ... V_{5V}]	
Ausgangspegel „low“ Output level „low“		[V]	0 [0 ... 0.6]	
Max. Strombelastbarkeit Max. current carrying capacity		[mA]	10	
Ausgangsimpedanz @ 1 kHz Output impedance @ 1 kHz		[kΩ]	≥ 9	
Eingangssignal Remote EIN/AUS U_{Rmt} / Input signal Remote ON/OFF U_{Rmt}				
Eingangspegel „high“ → Motor AUS Input level „high“ → motor OFF		[V]	5 [3.9 ... 5.5]	
Eingangspegel „low“ → Motor EIN Input level „low“ → motor ON		[V]	0 [0 ... 0.9]	
Eingangsimpedanz @ 1 kHz Input impedance @ 1 kHz		[kΩ]	≥ 1.8	

Tab. 12 (part 2): Connection plan motor electronics N 920 AP.29DC-B

Ausgangssignal Fehler U_{Fit} / Output signal fault U_{Fit}		
Eingangspegel „high“ → Fehler vorhanden Input level „high“ → error detected	[V]	5 [3.9 ... 5.5]
Eingangspegel „low“ → kein Fehler Input level „low“ → no error	[V]	0 [0 ... 0.9]
Max. Strombelastbarkeit Max. current carrying capacity	[mA]	10
Ausgangs impedanz @ 1kHz Output impedance @ 1kHz	[k Ω]	≥ 9

Tab. 12 (part 3): Connection plan motor electronics N 920 AP.29DC-B

i If the black wire is used as voltage source and at the same time as the default control voltage for the white wire, the output voltage decreases when the voltage source is under load. At the same time the default voltage for the white wire decreases. Because of this the nominal final speed can no longer be reached.

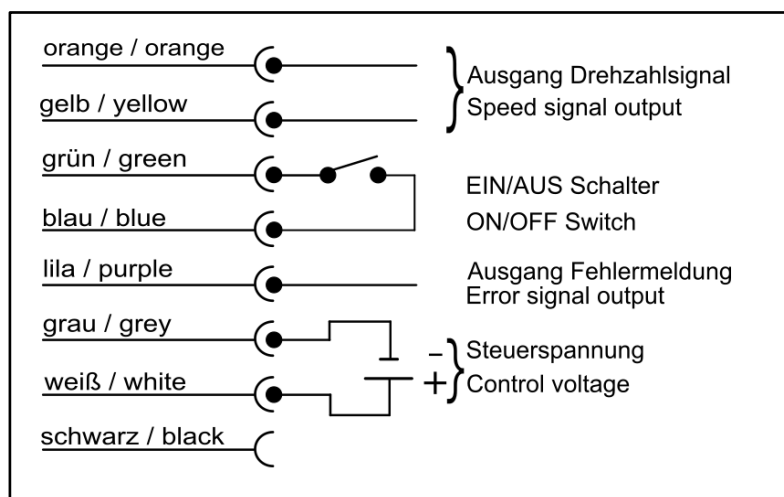


Fig. 10: Exposition Control without Potentiometer

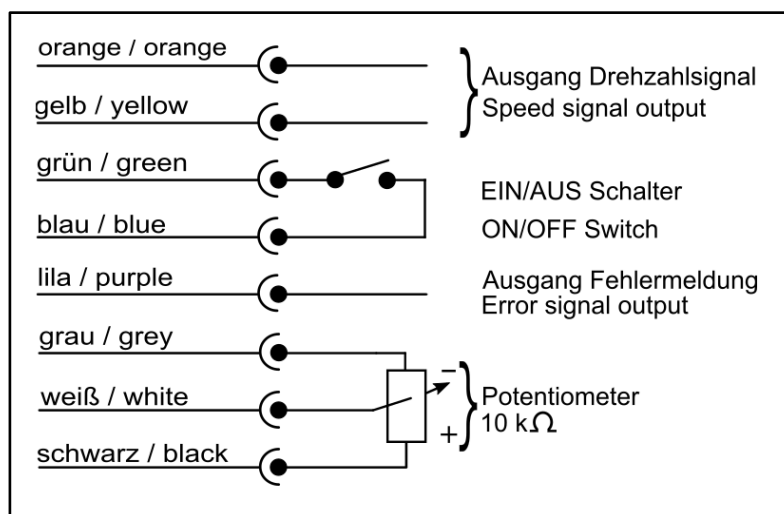


Fig. 11: Exposition Control with Potentiometer

8.2.1. Speed control

DC-B (constant speed)

The motor drives the pump at a constant, unchangeable speed across the entire permissible pressure range.

.29DC-B (regulated speed)

The motor drives the pump at a changeable speed between n_{\min} and n_{\max} . Speed is specified via the control voltage.

8.2.1.1. Speed input (.29 versions)

Speed range The speed range of $n_{\min} \dots n_{\max}$ is shown scaled to the control voltage U_{Ctrl} :

- $U_{\text{Ctrl min}}: 0.1 \text{ V}$
- $U_{\text{Ctrl max}}: 5.0 \text{ V}$

If the control voltage is less than $U_{\text{Ctrl min}}$, the motor is OFF.

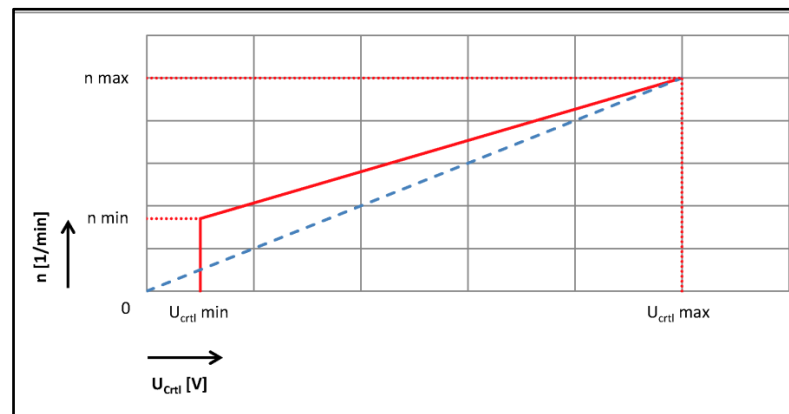


Fig. 12: Control-voltage/speed curve (standard)

Speed specification Speed is specified through the 8-pin controller connection, (white wire, see Tab. 12).

Optional analog settings for control voltage input

The following additional settings can be made at the factory upon request:

- Modify control voltage values $U_{\text{Ctrl min}}$ and $U_{\text{Ctrl max}}$
- If the control voltage is less than $U_{\text{Ctrl min}}$, the motor will be ON.

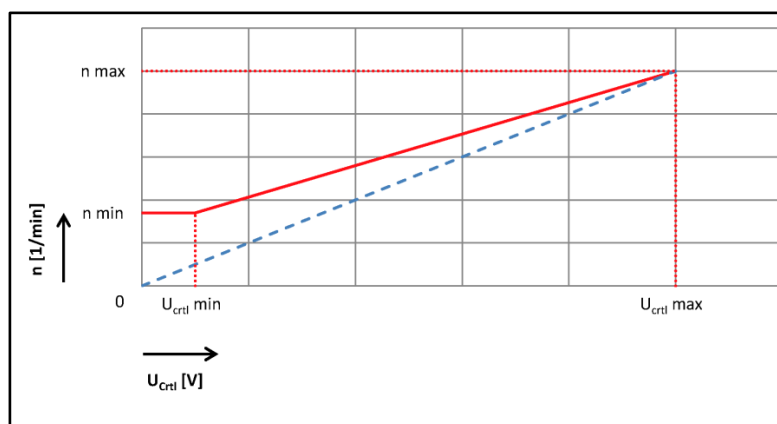


Fig. 13: Scaled control-voltage/speed curve (optional)

8.2.1.2. Speed output (.29 versions)

Speed output Speed is outputted through the 8-pin controller connection (yellow wire, see Tab. 12).

The motor controller generated speed-synchronized pulse-width modulation (see Fig. 14).

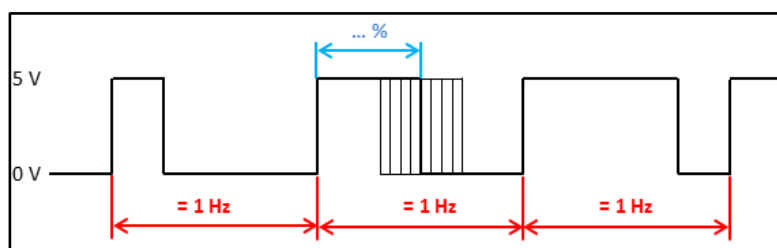


Fig. 14: Analog speed output (standard)

Optional speed output

The motor controller generates a speed-synchronized right-angle frequency with 5V TTL level (see Fig. 15).

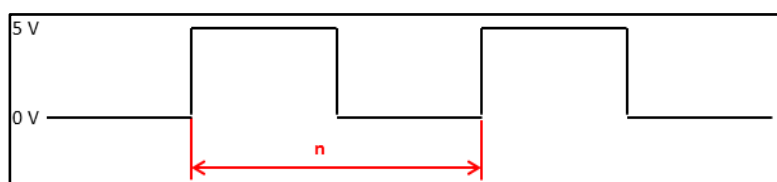


Fig. 15: Digital speed output (optional)

8.2.2. Remote ON/OFF (.29 versions)

Remote ON/OFF Remote ON/OFF is through an 8-pin controller connection (green wire, see Tab. 12).

i To start the motor, the green wire must be bridged to the ground of the controller connection (grey wire, blue wire or orange wire).

8.2.3. External digital activation (.29 versions, optional)

External activation

If desired, the pump motor can be activated externally. This requires a special setting at the factory (contact data: see www.knf.com).

External activation is through the 6-pin communication connection (see Fig. 9).

Connector type: Micro-Match Female Top Entry

Part no.: 7-215079-6

i When the motor is activated externally, the control inputs are inactive.

Connection communication plug (see Fig. 9)

PIN 1 – do not connect

PIN 2 – do not connect

PIN 3 – GND

PIN 4 – 5V (max. 50 mA)

PIN 5 – TX MBLC

PIN 6 – RX MBLC

Motor connection options – external control unit

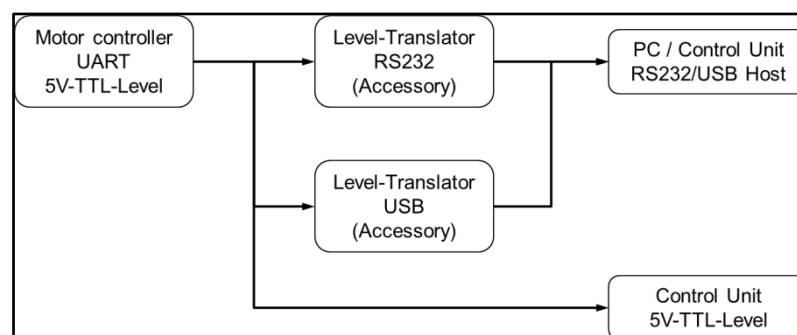


Fig. 16: External activation options (optional)

The following motor functions can be controlled:

- Motor remote ON/OFF
In the factory condition, the motor is OFF when operating voltage is applied. However, as an option the motor can be ON when operating voltage is applied.
- Motor speed
Setting motor speed within speed limits n_{\min} and n_{\max} .
- Read-out of the following process parameters:
 - Actual/Nominal motor speed
 - Control limit of motor speed
 - Operating current of the motor
 - Temperature of the motor controller
 - Fault status
 - Software version number

Interface protocol The connection between the PC and motor controller can be operated as an RS-232 interface. Accordingly, in the operating system it is managed as an additional COM connection and can be addressed with conventional terminal software.

Interface configuration

- Baud rate: 57600 bits/s
- Data bits: 8
- Parity: none
- Stop bits: 1
- Flow control: none

Tables Tab. 13 to Tab. 15 contain the necessary command sets, shown as ASCII characters. When transmitting, the commands must be followed by ASCII character <CR> (carriage return, decimal value 013). The underlined expressions are not characters, but symbols as explained in table Tab. 15.

Parameter	Command*	Function	Reply
Motor	dB	Start	<u>S</u> ; <u>E</u>
	dE	Stop	<u>S</u> ; <u>E</u>
Speed	dSnnnn [nnnn = speed value]	Set nominal speed	<u>ns</u> ; <u>E</u>

Tab. 13: Control commands

* A pause of at least 25 ms is required after the "dB" instruction set.

Parameter	Command	Reply
Actual motor speed; operating current of the motor; temperature of the motor controller; Fault status	pP	<u>ni</u> ; <u>ii</u> , <u>ti</u> , <u>ei</u> , <u>E</u>
Fault status (single value)	gP	<u>ei</u> ; <u>E</u>
Nominal motor speed	gS	<u>ns</u> ; <u>E</u>
Minimum possible motor speed	gSl	<u>nl</u> ; <u>E</u>
Maximum possible motor speed	gSh	<u>nh</u> ; <u>E</u>
Software version number	iV	<u>V</u> ; <u>E</u>

Tab. 14: Read commands

Symbol	Interpretation	Meaning
<u>E</u>	Announcement of completion	0 command cannot be completed
		1 command completed
		? command unclear
<u>S</u>	Status message	For service only
<u>V</u>	Version number	e.g. 01.018
<u>ni</u>	Actual motor speed	Value [min ⁻¹]
<u>ns</u>	Nominal motor speed	Value [min ⁻¹]
<u>nl</u>	Minimum nominal motor speed	Value [min ⁻¹]
<u>nh</u>	Maximum nominal motor speed	Value [min ⁻¹]
<u>ii</u>	operating current of the motor	Value [mA]
<u>ti</u>	temperature of the motor controller	Value [°C]
<u>ei</u>	Fault status	16 bit value

Tab. 15: Symbols

The symbols represent the ASCII codes of sequences of digits any length. The controller processes input values only as whole numbers (integers).

Interface level

i See p. 24 for pin assignment of the motor controller's communication plug.

Parameter	Value
Rx KNF MBLC	Low: 0V...0.9V High: 4.2V...5.2V
Tx KNF MBLC	Low: 0V...0.6V High: 4.5V...5.2V

Tab. 16

9. Servicing

9.1. Servicing schedule

Component	Servicing interval
Pump	<ul style="list-style-type: none"> - Regular inspection for external damage or leaks. - Regular inspection for noticeable changes in noise and vibration
Tube connection	<ul style="list-style-type: none"> - Regular inspection for external damage or leaks.
Diaphragm and valve plates	<ul style="list-style-type: none"> - Replace at the latest, when pump output decreases. - Change if pressure or flow rate of the pump changes for no apparent reason.
Silencer/filter (accessory)	<ul style="list-style-type: none"> - Change if it is dirty.

Tab. 17

9.2. Cleaning

i When cleaning, make sure that no liquids enter the inside of the housing.

9.2.1. Flushing pump

➔ Before switching off the pump, flush it with air (if necessary for safety reasons: with an inert gas) for about five minutes under atmospheric conditions (ambient pressure).

9.2.2. Cleaning pump

➔ Only use solvents for cleaning if the head materials cannot be attacked (check the resistance of the material!).

➔ If compressed air is available, blow out the components.

9.3. Replacing diaphragm and reed valves

- Conditions
- N 920 APE-W:
Pump is switched off and mains plug is removed from the socket
 - N 920 APDC-B:
Pump disconnected from mains and de-energized
 - Pump is clean and free of hazardous materials
 - Tubes removed from pump's pneumatic inlet and outlet

Spare parts/tools

Spare part/tool
Service Set (according to Chapter 11)
Allen key 4 mm
Felt-tip pen
Stabilization diaphragm (if required)

Tab. 18

Information on procedure ➔ Always replace diaphragm and valve plates together to maintain the pump performance.

**WARNING**

Health hazard due to dangerous substances in the pump!

Depending on the substance transferred, caustic burns or poisoning are possible.

- ➔ Wear protective clothing if necessary, e.g. protective gloves.
- ➔ Flush pump before replacing the diaphragm and valve plates (see Chapter 9.2.1).

- 1 Head cover
- 2 Screw
- 3 Intermediate plate, head 1
- 4 Valve plate
- 5 O-ring (Ø 24 x 2)
- 6 O-ring (Ø 5.5 x 2)
- 7 Intermediate plate, head 2
- 8 Intermediate plate, head 3
- 9 Diaphragm, head 1
- 10 Diaphragm, head 2
- 11 Diaphragm, head 3
- 12 Connecting rod, head 2
- 13 Connecting rod, head 3
- 14 Diaphragm recording
- 15 Pump housing
- 16 Fan
- 17 Stabilization diaphragm
- 18 O-ring (Ø 5.5 x 2)
- 19 Screw

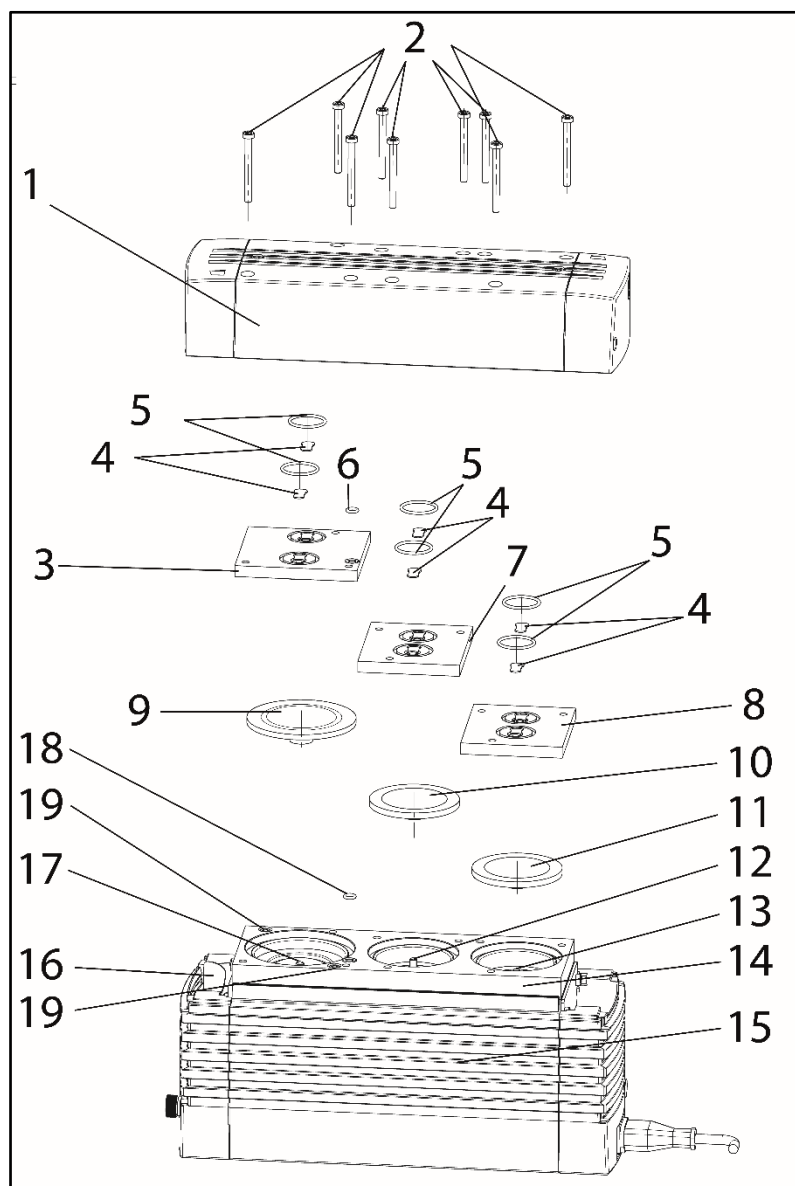


Fig. 17: Exploded drawing N 920 APE-W

Remove pump head

1. Undo the nine screws (2) in the head cover (1) and lift the head cover off the pump housing (15) (see Fig. 17)
2. Mark the position of intermediate plate (3) and diaphragm recording (14) relative to each other by a drawing line with a felt-tip pen. This helps avoid incorrect assembly later.
3. Mark the position of intermediate plate (7) and diaphragm recording (14) relative to each other by two drawing lines with a pencil.
4. Mark the position of intermediate plate (8) and diaphragm recording (14) relative to each other by three drawing lines with a pencil.
5. Lift the intermediate plates (3), (7) and (8) off the diaphragm recording.

Change diaphragms

1. Turn the three diaphragms (9), (10) and (11) outwards with your hands, counter-clockwise. For this, turn the fan (16) such that you can easily grip each diaphragm with your hands.

i For diaphragms (10) and (11):
Make sure the diaphragm spacers being between diaphragm and connecting rod do not fall into the pump housing.
If diaphragm spacers should adhere to the diaphragms, take them off and put them in the thread of the corresponding connecting rod.
The same number of diaphragm spacers must be mounted as were used for the previous assembly. This is necessary, in order to ensure the pump's pneumatic performance.

2. Remove the valve plates (4) and O-rings (5) from the intermediate plates (3), (7) and (8).
3. Remove O-ring (6) from the intermediate plate (3).
4. Remove O-ring (18) from diaphragm recording (14).

i Carry out steps 5 to 11 only if stabilization diaphragm also shall be changed.

5. Loosen the two screws (19) and remove the diaphragm recording (14) from the pump housing (15).
The stabilization diaphragm (17) is now visible.
6. Remove the existing diaphragm spacer(s) from the stabilization diaphragm (17).

i It is important to later re-install the same quantity of diaphragm spacers in order to ensure the pump's pneumatic performance.

7. Use the assembly key to loosen the stabilization diaphragm (17) and then manually screw it out (in the counterclockwise direction).

8. Screw in the new stabilization diaphragm (17) and tighten it hand-tight with the assembly key.
9. Put the diaphragm spacer(s) onto the thread of the new stabilization diaphragm (17) (same number).
10. Place the diaphragm recording (14) onto the pump housing (15).

i The diaphragm recording must be aligned flush with the pump housing (15). This is important for later installation of the diaphragm (9).

11. Tighten the two screws (19) to hand-tightness.

i Begin with the outermost screw and make sure that the diaphragm recording (14) does not move while you are tightening the screws.

12. Screw the new diaphragm (9) into the thread of stabilization diaphragm (17) and tighten it by hand.

i To ensure proper pump performance, it is important to maintain a uniform distance everywhere between the outer edge of the diaphragm (9) and the diaphragm recording (14). If the distance is not uniform, you must re-loosen the screws (19) and re-align the diaphragm receiver so the distance is the same everywhere.

i Before you finally tighten the diaphragms, you are recommended to move the diaphragm to the upper dead center by rotating the fan (16).

13. Screw the new diaphragms (10) and (11) onto the connecting rods (12) and (13) and tighten it by hand.

Mount valve plates, intermediate plates and head cover

1. Lay the new O-ring (18) on the diaphragm recording (14).
2. Lay the new valve plates (Fig. 18/4) and the new O-rings (5) on the intermediate plates (3), (7) and (8).

i Upper and lower sides of the valve plates are identical. For correct position see Fig. 18.

3. Lay the new O-ring (6) on the intermediate plate (3).
4. Place the intermediate plates (3), (7) and (8) on the diaphragm recording (14) in the position indicated by the drawing lines.
5. Place the head cover (1) on the pump housing (15); tighten the screws (2) hand tight, evenly and diagonally.
6. Dispose of the old diaphragms, valve plates and O-rings properly.

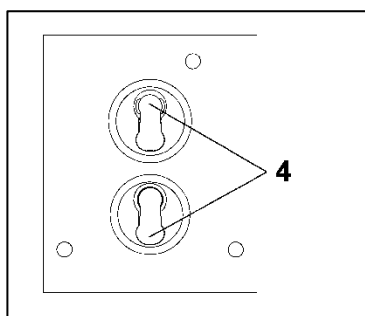


Fig. 18: Position of valve plates

Final steps

1. Reconnect suction and pressure line to the pump.
2. Reconnect the pump to the electricity supply.

If you have any questions about servicing, call your KNF technical adviser (contact data: see www.knf.com).

10. Troubleshooting



DANGER

Extreme danger from electrical shock!

- Disconnect the pump power supply before working on the pump.
- Make sure the pump is de-energized and secure.

→ Check the pump (see Tab. 19 and Tab. 20).

Pump does not transfer	
Cause	Fault remedy
Pump is not connected with the power source.	→ Connect pump with the power source.
No voltage in the power source.	→ Check room fuse and switch on if necessary.
The pump's overcurrent protection circuit has responded.	→ Remove the pump from the source of electrical power. → Determine and eliminate the cause of the overcurrent (e.g. improper pressure, liquid in the pump heads). i The pump must be unplugged for some seconds before the electronics will allow to restart.
Connections or lines blocked.	→ Check connections and lines. → Remove blockage.
External valve is closed or filter is clogged.	→ Check external valves and filters.
Condensate has collected in pump head.	→ Detach the condensate source from the pump. → Flush pump (see Chapter 8.2.1).
Diaphragm or valve plates are worn.	→ Replace diaphragm and valve plates (see Chapter 9.3).

Tab. 19

Flow rate, pressure or vacuum too low	
The pump does not achieve the output specified in the Technical data or the data sheet.	
Cause	Fault remedy
Condensate has collected in pump head.	→ Detach the condensate source from the pump. → Flush pump (see Chapter 9.2.1).
There is gauge pressure on pressure side and at the same time vacuum or a pressure above atmospheric pressure on suction side.	→ Change the pressure conditions.
Pneumatic lines or connection parts have an insufficient cross section.	→ Disconnect pump from system to determine output values. → Eliminate throttling (e.g. valve) if necessary. → Use lines or connection parts with larger cross section if necessary.
Leaks occur on connections, lines or pump head.	→ Check that tubes sit correctly on hose nozzles. → Replace leaky tubes. → Eliminate leaks

Flow rate, pressure or vacuum too low	
The pump does not achieve the output specified in the Technical data or the data sheet.	
Cause	Fault remedy
Connections or lines completely or partially clogged.	→ Check connections and lines. → Remove the clogging parts and particles.
Head parts are soiled.	→ Clean head components.
Diaphragm or valve plates are worn.	→ Replace diaphragm and valve plates (see Chapter 9.3).
Replaced diaphragms and valve plates.	→ Check that the spacers have been replaced onto the diaphragm screw thread. → Check head connection and hose connections for leaks. → Possibly carefully tighten the screws of the head cover crosswise.

Tab. 20

Fault cannot be rectified

If you are unable to determine any of the specified causes, send the pump KNF Customer Service (contact data: see www.knf.com).

1. Flush the pump (see Chapter 9.2.1).
2. Clean the pump (see Chapter 9.2.2).
3. Send the pump, together with completed Health and Safety Clearance and Decontamination Form, to KNF stating the nature of the transferred medium.

11. Spare parts and accessories

11.1. Spare parts

A Service Set contains all replacement parts needed for one complete service:

- 3 diaphragms
- 6 O-rings (Ø 24 x 2)
- 6 valve plates
- 2 O-rings (Ø 5.5 x 2)

Spare parts	Order No.
Service set for N 920 APE-W	057456
Service set for N 920 APDC-B	057456
Stabilization diaphragm	056523

Tab. 21

11.2. Accessories

Accessories	Order No.
Silencer/Filter G 1/8	007006
Small flange connection for suction or pressure side, stainless steel, KNF 16	046625
Hose connector (G 1/8, for tube ID 9)	029113
Sealing for hose connector	026906
Completely connectorized control cable (analog or digital controlling)	On request
Assembly key for stabilization diaphragm	116885
PWM analog voltage converter Function: Smoothing of the speed output signal into an analog voltage output signal into an analog voltage output and simultaneous transformation of 5V to ≤ 5V.	On request
External potentiometer for setting of the speed	On request
RS232 Level-Translator with SUB-D9 plug	On request
RS232 Level-Translator with Micro-USB plug	On request

Tab. 22

12. Returns

Preparing for return

1. Flush the pump with air for a few minutes (if necessary for safety reasons: with inert gas) at atmospheric pressure to free the pump head of dangerous or aggressive gases (see Chapter 9.2.1).

i Please contact your KNF sales partner if the pump cannot be flushed due to damage.

2. Remove the pump.
3. Clean up the pump (see chapter 9.2.2).
4. Send the pump together with the completed Health and Safety Clearance and Decontamination Form to KNF, stating the nature of the transferred medium.
5. Pack the device securely to prevent further damage to the product. If necessary, request original packaging for a fee.

Returns

KNF shall undertake to repair the pump only under the condition that the customer presents a certificate regarding the medium that is pumped and the cleaning of the pump. In this case too, old devices can be returned. Please follow the instructions at [knf.com/repairs](https://www.knf.com/repairs) here.

Contact your KNF sales partner directly if you require additional support for your return service.